

Space Weather Technical Forecast

Issued on Thursday, 11 April 2024 at 01:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Increasing solar activity likely in the coming days. Slight chance of G1 Minor geomagnetic storms later in the period given expected coronal hole influence.

Analysis of Space Weather Activity over past 24 hours.

Solar Activity: Solar activity is Low, with a peak flare of C4.0 observed at 10/1151 UTC from over the northwestern limb, most likely from AR3629 recently rotated off the visible disc. There are five sunspot regions on the visible disc. The largest of these is AR3628 in the northwest, which has been reclassified as H α /Alpha given continued fading of any trailing spots. One new small and simple spot region has appeared in recent hours in the northeast, with AR3635 also in this region being numbered.

No Earth-directed CMEs were observed in available coronagraph imagery. However the current visible disc is heavily populated by filaments - perhaps rendered more durable by the lack of flares to de-stabilise them - however there are signs of a recent lift off or destabilisation from a reasonably large filament in the northern disk and imagery will be monitored closely for signs of an associated CME.

Solar Wind / Geomagnetic Activity: Solar wind parameters, as measured at L1 by DSCOVR/ACE were indicative of an ongoing minor coronal hole high-speed stream influence. Solar wind speeds were at slightly elevated levels, generally between 420-480 km/s. The solar wind density was likely near average throughout. Total Interplanetary Magnetic Field (IMF), B $_t$, was weak. The north-south component, B $_z$, varied between +7 and -6 nT, with erratic variations between directions. The phi angle was mainly positive (away from the Sun).

Resultant Geomagnetic activity was Quiet to Unsettled.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) observed at GOES18 was at background levels.

High energy electron flux (greater than 2MeV) observed at GOES16 was at background to moderate levels. The associated 24-hour fluence remained well below the Active (1e8 integrated flux) threshold, on an increasing, then steady trend, with a value of 1.07e7 integrated pfu recorded at 11/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain generally Low, but with an increasing chance of Moderate activity into the period with the potential return of multiple Ex-sunspot regions over the eastern solar horizon.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs feature in the forecast. Easing minor coronal hole high-speed stream influences are expected through Days 1-2 (11-12 Apr)

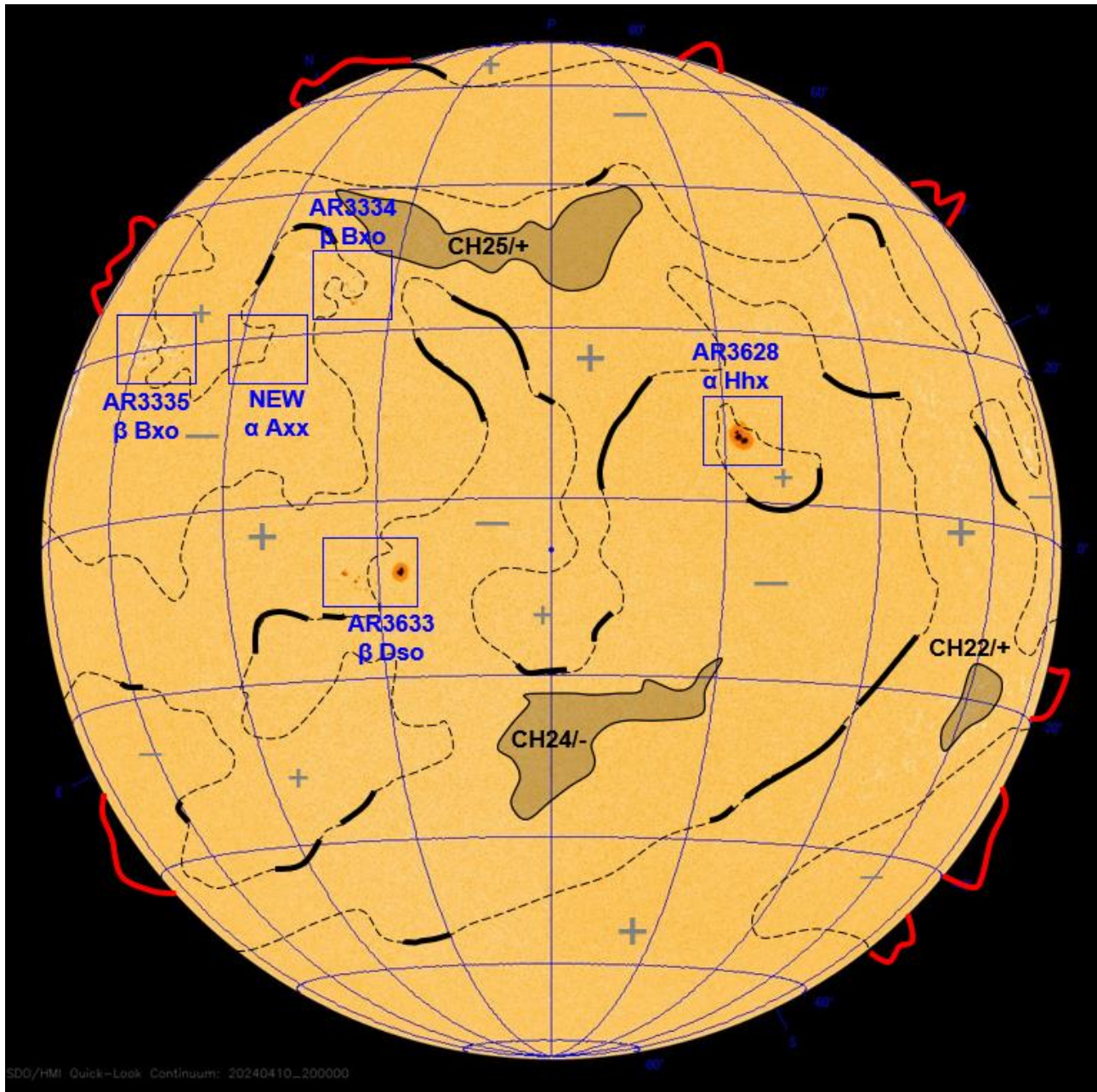
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with speeds persisting at slightly elevated levels at first before easing to normal background. Further coronal hole enhancement is possible into Days 3 and 4 (13-14 Apr) with winds perhaps increasing to slightly elevated or elevated levels once again.

Geomagnetic activity is expected to be Quiet to Unsettled with a chance of isolated Active intervals early on Day 1 (11 Apr). Mainly Quiet activity is then expected Day 2 (12 Apr). Activity likely increasing to become more generally Unsettled with Active intervals likely and a slight chance of G1 Minor Geomagnetic storm intervals into Days 3 and 4 (13-14 Apr).

Energetic Particles / Solar Radiation: High energy proton flux as observed by GOES-18 is expected to persist at background levels. High energy electron flux at GOES16 is expected to continue at background to moderate levels. The associated 24-hour electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 10/2000UTC.



Key: Filament —, Prominence —, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

No CMEs feature in the current forecast, however there are a higher number of filaments than is typical on the Earth-facing side of the Sun – this increasing the risk of potential Earth directed CME should any of these erupt in the coming days.

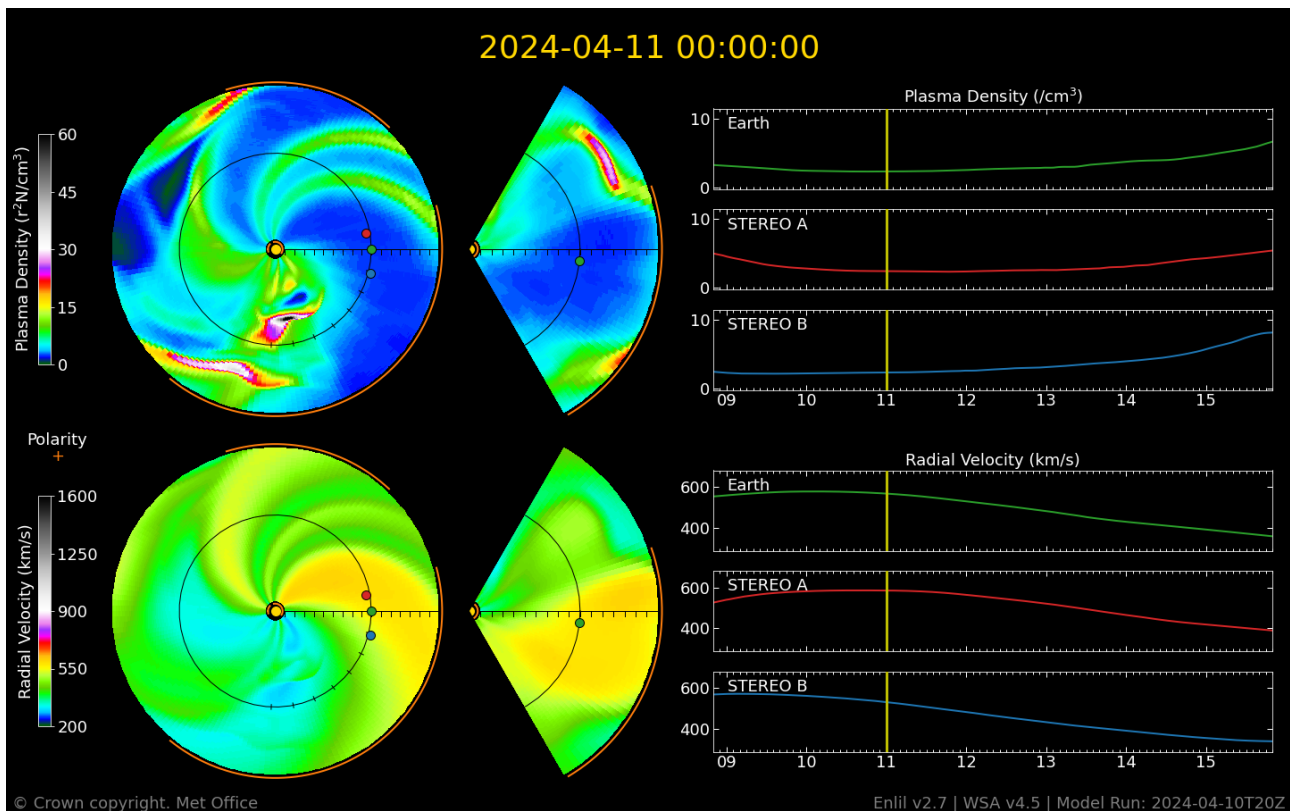
Solar wind speeds are currently slightly elevated most likely due to weak positive coronal hole high-speed stream influence from CH22/+. Speeds should begin to ease from Day 1 (11 Apr) onwards, likely returning towards background levels. A further enhancement is possible into Day 3 (13 Apr) due to negative polarity CH24/- currently near centre disk. This is a recurrent feature, but has changed in appearance since the previous rotation from a small, symmetrically shaped coronal hole, to a larger but more elongated feature. Any connection will potentially increase speeds to become slightly elevated or perhaps elevated, though given the irregular, elongated shape of the coronal hole, confidence in the onset of the high-speed stream and subsequent geomagnetic effects is lower than usual.

Another factor in the lower than average confidence in the geomagnetic forecast is MOSWOC ENLIL, which is suggesting a notable high speed stream throughout the early period, with winds peaking around 550km/s (elevated) on Day 1 (11 Apr) before declining to slightly elevated by the end of Day 4 (14 Apr). Given current conditions in ENLIL verifying poorly with actuality, it is considered likely that ENLIL is significantly overdone in its forecast. ENLIL also appears to have underrepresented coronal hole CH24/-.

Geomagnetic activity is expected to be Quiet to Unsettled with a chance of isolated Active intervals early on Day 1 (11 Apr). Mainly Quiet activity is then expected Day 2 (12 Apr). Activity likely increasing to become more generally Unsettled with Active intervals likely and a slight chance of G1 Minor Geomagnetic storm intervals into Days 3 and 4 (13-14 Apr).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	1	20	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Latest MOSWOC ENLIL output showing erroneous enhancement currently forecast, and lack of CH24/- representation. Output not preferred.



Radio Blackouts - X-Ray Flares:

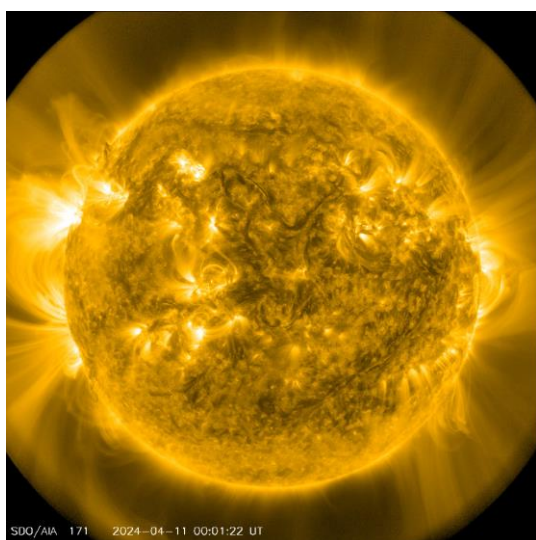
The visible side of the Sun is currently populated by five predominantly simple sunspot regions, and the risk of significant X-ray flares remains lower than it has been for some time. The chances of significant flares could, however, rise significantly in the coming days given the expected arrival of numerous Ex active regions over the eastern solar horizon, including at least one potentially large and complex sunspot group.

SDO/AIA 171 imagery indicates modest magnetic looping approaching the northeast limb. This thought likely Ex-AR3621, which left the disc on 27 Mar as a simple bipolar group. This is due to rotate onto the disc Day 1 (11 Apr). Later on Day 2 into Day 3 (12-13 Apr), Ex-regions AR3614, AR3615 and AR3623 are forecast to potentially rotate over the eastern solar horizon. Ex-AR3615 was a significant region on the last rotation and is thought likely to have survived its transit of the far side - supported by imagery from the Mars Perseverance Rover as well as ongoing evidence on far-side seismographs. The chances of significant flares should rise to nearer expected values for this stage of the solar cycle during the period, with the most notable uptick expected into Days 3 and 4 (13-14 Apr).

Solar activity is expected to remain generally Low, but with an increasing chance of Moderate activity into the period.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	20	30	30
Very Active	R3 to R5 X Class	No	1	1	5	5

Figure 3: Latest SDO/AIA 171 imagery showing looping approaching the eastern limb.



Solar Radiation Storms - (High Energy Protons):

High energy proton flux as observed by GOES18 is at background levels. Solar radiation storms are considered a background risk during the period given the lack of appropriately active sunspot regions moving into in the western portion of the disc.

Radiation Storms	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	1	1	1	1
Very Active	$\geq \text{S3}$ *	No	1	1	1	1

* $\text{S3} \geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)

High Energy Electrons Event ($\geq 2\text{MeV}$):

High energy electron flux is currently at normal background, reaching moderate levels diurnally with this pattern expected to continue into the period in the absence of significant external factors with any high speed streams expected to be minor; lacking the impetus necessary to significantly increase electron populations at GEO. Electron fluence is likewise forecast to remain below the Active ($1\text{e}8$ integrated pfu) threshold throughout the period, with MOSWOC REFM giving reasonable guidance, suggesting the potential for a slight rise during Days 1-2 (11-12 Apr) before reverting to a flat trend.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1\text{e}8$	No	5	5	1	1
Very Active	$\geq 2 \text{ MeV}$ $\geq 1\text{e}9$	No	1	1	1	1

Figure 4: Latest MOSWOC REFM model output.

